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(54) Title: STILBENE DERIVATIVES AS ANTICANCER AGENTS

## (57) Abstract

The present invention relates to stilbene derivatives which possess utility as anti-cancer agents. The compounds can be used to treat cancers which are susceptible to treatment therewith, and can be utilized in a method of treating such cancers. Pharmaceutical compositions containing the compounds are disclosed. Three preferred compounds among those disclosed are (Z)-1-(4-methoxyphenyl)-2-(3,4,5-trimethoxyphenyl)ethene, (Z)-1-(4-methylphenyl)-2-(3,4,5-trimethoxyphenyl)ethene, and 4-methyl-3',4',5'-trimethoxybenzylaniline hydrochloride.

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## AMENDED CLAIMS

[received by the International Bureau on 18 November 1993 (18.11.93);  
original claims 1-205 replaced by new claims 1-46 (12 pages)]

1

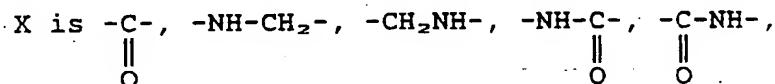
1. A pharmaceutical composition comprising a pharmaceutically effective amount of a compound having the formula:

5



and pharmaceutically acceptable salts thereof, wherein:

- Ar and Ar<sub>1</sub> are independently aryl or heteroaryl; and Ar may be mono, di, tri, or tetrasubstituted with R' and Ar<sub>1</sub> may be mono, di, tri, or tetrasubstituted with R";



- 15  $-(Y_2)(Y_3)C-C(Z_2)(Z_3)-$  or cis or trans ethylene radical of the formula  $-(Y_1)C=C(Z_1)$ , CH<sub>2</sub>, or CHOH;

Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub>, Z<sub>1</sub>, Z<sub>2</sub> and Z<sub>3</sub> are independently hydrogen, lower alkyl, lower alkoxy, carboxy, lower carbalkoxy, COONR<sub>13</sub>R<sub>14</sub>, cyano, or COOQNR<sub>15</sub>R<sub>16</sub>;

- 20 R<sub>13</sub>, R<sub>14</sub>, R<sub>15</sub> and R<sub>16</sub> are independently hydrogen or lower alkyl;

Q is lower alkylene;

- each R' may be the same or different and consists of R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub>, and each R" may be the same or different and consists of R<sub>5</sub>, R<sub>6</sub>, R<sub>7</sub> and R<sub>8</sub>;

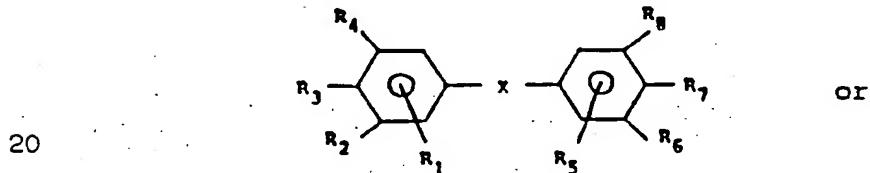
R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub>, R<sub>7</sub> and R<sub>8</sub> are independently hydrogen, lower alkyl, halo, amino, lower alkylamino, diloweralkylamino, lower alkoxy, lower arylalkoxy, cyano, aryloxy, mercapto, lower alkyl thio,

- 30 amino lower alkyl, carboxy, carbolower alkoxy, CONHR<sub>9</sub>, NHCO(R<sub>9</sub>), lower alkanoyl, nitro, CF<sub>3</sub>, lower alkyl carbonyloxy, amino lower alkoxy, lower alkyl amino lower

1 alkoxy, dilower alkylamino lower alkoxy, aminolower alkylene oxycarbonyl, lower alkylamino-loweralkyleneoxy carbonyl, dilower alkylamino lower alkylene oxy carbonyl, OSi(R<sub>10</sub>R<sub>11</sub>R<sub>12</sub>) or Si(R<sub>17</sub>)(R<sub>18</sub>)(R<sub>19</sub>) and at least two of R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub>, R<sub>7</sub> and R<sub>8</sub> is loweralkoxy;

R<sub>9</sub> is hydrogen or lower alkyl;  
 10 R<sub>10</sub>, R<sub>11</sub>, R<sub>17</sub>, R<sub>18</sub> and R<sub>19</sub> are independently lower alkyl; R<sub>12</sub> is lower alkyl or lower alkoxy; and a pharmaceutical carrier therefor.

2. The pharmaceutical composition according to Claim 1 wherein Ar and Ar<sub>1</sub> are independently aryl.  
 15 3. The pharmaceutical composition according to Claim 1 or 2 having the formula:



pharmaceutically acceptable salts thereof.

4. The pharmaceutical composition according to any of Claims 1-3 wherein Y<sub>2</sub> and Z<sub>2</sub> are hydrogen.  
 25 5. The pharmaceutical composition according to any of Claims 1-4, wherein Y<sub>3</sub> and Z<sub>3</sub> are independently hydrogen, cyano or lower carbalkoxy.  
 30 6. The pharmaceutical composition according to any of Claims 1-5, wherein Y<sub>3</sub> is hydrogen or cyano and Z<sub>3</sub> is hydrogen, cyano or lower carbalkoxy.  
 7. The pharmaceutical composition according to any of Claims 1-6, wherein Z<sub>3</sub> and Y<sub>3</sub> are hydrogen.

1        8.. The pharmaceutical composition according to  
any of Claims 1-3 wherein at least one of Y<sub>1</sub> and Z<sub>1</sub> is  
hydrogen.

5        9. The pharmaceutical composition of any of  
Claims 1-3 or 8 wherein Y<sub>1</sub> is COOH, COOMe, CONHMe,  
COONHET, COO(CH<sub>2</sub>)NET<sub>2</sub>, COO(CH<sub>2</sub>)<sub>2</sub>NMe<sub>2</sub> or hydrogen and Z<sub>1</sub>  
is hydrogen or COOH.

10      10. The pharmaceutical composition according  
to any of claims 1-3 or 8-9 where X is cis or trans  
CH=CH.

15      11. The pharmaceutical composition according  
to any of Claims 1-10 wherein R<sub>5</sub>, R<sub>6</sub>, R<sub>7</sub> and R<sub>8</sub> are  
independently hydrogen, lower alkoxy, thio alkyl, lower  
alkyl, amino, lower alkylamino, diloweralkylamino,  
loweralkyl carbonyloxy, aminoalkoxy, lower alkylamino  
carbonyloxy or dilower alkylamino carbonyloxy.

20      12. The pharmaceutical composition according  
to any of Claims 1-11 wherein R<sub>6</sub>, R<sub>7</sub> and R<sub>8</sub> are  
independently hydrogen, lower alkoxy, halo, amino, lower  
alkylamino, dilower alkylamino, lower alkyl thio or  
lower alkyl.

25      13. The pharmaceutical composition according  
to any of Claims 1-12 wherein R<sub>1</sub>, R<sub>2</sub> and R<sub>4</sub> are  
independently hydrogen lower alkyl or lower alkoxy;

R<sub>3</sub> is hydrogen, lower alkyl, lower alkoxy,  
arylalkoxy, loweralkyl carbonyloxy or OSi(R<sub>10</sub>R<sub>11</sub>R<sub>12</sub>);  
R<sub>5</sub> is hydrogen, lower alkyl, halo or lower  
alkoxy;

30      R<sub>6</sub> and R<sub>8</sub> are independently hydrogen, lower  
alkyl or lower alkoxy;

R<sub>7</sub> is hydrogen, lower alkoxy, lower alkyl,  
halo, lower alkyl carbonyloxy, OSi(R<sub>10</sub>R<sub>11</sub>R<sub>12</sub>),

1 Si( $R_{17}$ )( $R_{18}$ )( $R_{19}$ ), amino, dilower



alkylamino, NHC- $R_9$ , diloweralkylamino lower alkoxy,  
lower alkylthio, mercapto or nitro;

5  $R_{10}$ ,  $R_{11}$ ,  $R_{12}$ ,  $R_{17}$ ,  $R_{18}$  and  $R_{19}$  are  
independently lower alkyl; and  
 $R_9$  is lower alkyl or hydrogen.

14. The pharmaceutical composition according  
10 to any of Claims 1-13 wherein  $R_7$  is lower alkoxy,  
hydrogen, halo, amino, lower alkylamino, dilower  
alkylamino or lower alkyl thio.

15. The pharmaceutical composition according  
to any of Claims 1-14 wherein  $R_7$  is lower alkoxy, lower  
alkylamino or diloweralkylamino.

16. The pharmaceutical composition according  
15 to any of Claims 1-13 wherein  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_7$  and  $R_8$   
are independently lower alkoxy, hydrogen or lower alkyl.

17. The pharmaceutical composition according  
20 to any of Claims 1-16 where at least three and at most  
six of  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$  and  $R_8$  are lower  
alkoxy, wherein lower alkoxy is alkoxy having 1-4 carbon  
atoms.

18. The pharmaceutical composition according  
25 to any of Claims 1-17 wherein  $R_1$  and  $R_5$  are hydrogen.

19. The pharmaceutical composition, according  
to any of Claims 1-18 wherein at least three of  $R_1$ ,  $R_2$ ,  
 $R_3$  and  $R_4$  are lower alkoxy.

20. The pharmaceutical composition according  
30 to any of Claims 1-19 wherein  $R_2$ ,  $R_3$  and  $R_4$  are lower  
alkoxy.

1        21. The pharmaceutical composition according  
to any of Claims 1-20 wherein R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are lower  
alkoxy and R<sub>1</sub> is lower alkoxy.

22. The pharmaceutical composition according  
5 to any of Claims 1-21 wherein X is -C-.



23. The pharmaceutical composition according  
to any of Claims 1-21 wherein X is -CHOH-.

24. The pharmaceutical composition according  
10 to any of Claims 1-21 wherein X is -NH-CH<sub>2</sub> or -CH<sub>2</sub>NH-.

25. The pharmaceutical composition according  
to any of Claims 1-21 wherein X is -NHC- or -C-NH-.



15 26. The pharmaceutical composition according  
to any of Claims 1-21 wherein X is -(Y<sub>2</sub>)(Y<sub>3</sub>)C-C(Z<sub>2</sub>)(Z<sub>3</sub>).

27. The pharmaceutical composition according  
to any of Claims 1-21 wherein X is cis or trans  
(Y<sub>1</sub>)C=C(Z<sub>1</sub>).

20 28. The pharmaceutical composition according  
to any of Claims 1-27 wherein

X is cis HC=CH; R<sub>1</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>7</sub> are H and R<sub>2</sub>,  
R<sub>3</sub>, R<sub>4</sub> and R<sub>7</sub> is methoxy;

X is cis CH=CH; R<sub>1</sub>, R<sub>5</sub>, R<sub>7</sub> and R<sub>8</sub> are H; R<sub>2</sub>,  
R<sub>3</sub>, R<sub>4</sub> and R<sub>6</sub> are OCH<sub>3</sub>;

25 X is cis CH=CH; R<sub>1</sub>, R<sub>6</sub> and R<sub>8</sub> are H; R<sub>5</sub> is 2-  
Cl; R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub> and R<sub>7</sub> are OCH<sub>3</sub>;

X is cis CH=CH; R<sub>1</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>8</sub> are H; R<sub>7</sub> is  
Cl and R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are OCH<sub>3</sub>;

30 X is cis CH=CH; R<sub>1</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>8</sub> are H; R<sub>7</sub> is  
Br, and R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are OCH<sub>3</sub>;

1        X is cis CH=CH; R<sub>1</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>8</sub> are H; R<sub>7</sub> is NMe<sub>2</sub>; and R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub> are OCH<sub>3</sub>;

          X is cis CH=CH; R<sub>1</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>8</sub> are H; R<sub>7</sub> is OEt, and R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are OCH<sub>3</sub>;

5        X is cis CH=CH; R<sub>1</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>8</sub> are H; R<sub>7</sub> is OPr, and R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are OCH<sub>3</sub>;

          X is cis CH=CH; R<sub>1</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>8</sub> are H; R<sub>7</sub> is SMe, and R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are OCH<sub>3</sub>;

10      X is cis CH=CH; R<sub>1</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>8</sub> are H; R<sub>7</sub> is Me, and R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are OCH<sub>3</sub>;

          X is cis CH=CH; R<sub>1</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>8</sub> are H; R<sub>7</sub> is Et, and R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are OCH<sub>3</sub>;

          X is cis CH=CH; R<sub>1</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>8</sub> are H; R<sub>7</sub> is iPr, and R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are OCH<sub>3</sub>;

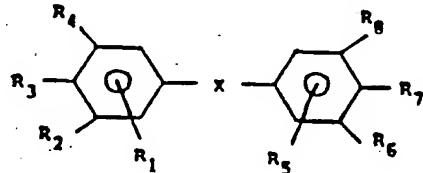
15      X is CH<sub>2</sub>CH<sub>2</sub>; R<sub>1</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>8</sub> are H; R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub> and R<sub>7</sub> are OCH<sub>3</sub>; or

          X is CHNH, R<sub>1</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>8</sub> are H and R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub> and R<sub>7</sub> are OCH<sub>3</sub>.

29. A method for treating cancer in an animal  
20 which comprises administering to said animal in need of such treatment an anti-cancer effective amount of a composition according to any of Claims 1-28.

30. The compound having the formula:

25



30

35

1 wherein:



5 independently hydrogen, lower alkyl, halo, amino, lower alkylamino, diloweralkylamino, lower alkoxy, lower arylalkoxy, cyano, aryloxy, mercapto, lower alkyl thio, amino lower alkyl, carboxy, carbolower alkoxy, CONHR<sub>9</sub>, NHCO(R<sub>9</sub>), lower alkanoyl, nitro, CF<sub>3</sub>, lower alkyl

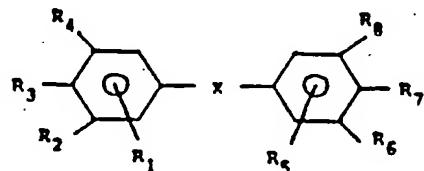
10 carbonyloxy, amino lower alkoxy, lower alkyl amino lower alkoxy, dilower alkylamino lower alkoxy, amino lower alkylene oxycarbonyl, lower alkylamino loweralkyleneoxy carbonyl, dilower alkylamino lower alkylene oxy carbonyl, OSi(R<sub>10</sub>R<sub>11</sub>R<sub>12</sub>) or

15 Si(R<sub>17</sub>)(R<sub>18</sub>)(R<sub>19</sub>) and at least two of R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub>, R<sub>7</sub> and R<sub>8</sub> is loweralkoxy;

R<sub>9</sub> is hydrogen or lower alkyl;

R<sub>10</sub>, R<sub>11</sub>, R<sub>12</sub>, R<sub>17</sub>, R<sub>18</sub> and R<sub>19</sub> are independently lower alkyl.

20 31. The compound having the formula



25

wherein X is a cis ethylene radical of the formula

-(Y<sub>1</sub>)C=C(Z<sub>1</sub>);

Y<sub>1</sub> and Z<sub>1</sub> are independently hydrogen, lower alkyl, lower alkoxy, carboxy, lower carbalkoxy, COONR<sub>13</sub>R<sub>14</sub>, cyano, or COOQR<sub>15</sub>R<sub>16</sub>;

- 1            $R_{13}$ ,  $R_{14}$ ,  $R_{15}$  and  $R_{16}$  are independently hydrogen or lower alkyl;
- 2            $Q$  is lower alkylene;
- 3            $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$  and  $R_8$  are
- 4        5 independently hydrogen, lower alkyl, halo, amino, lower alkylamino, diloweralkylamino, lower alkoxy, lower arylalkoxy, cyano, aryloxy, mercapto, lower alkyl thio, amino lower alkyl, carboxy, carbolower alkoxy,  $CONHR_9$ ,  $NHCO(R_9)$ , lower alkanoyl, nitro,  $CF_3$ , lower alkyl
- 6        10 carbonyloxy, amino lower alkoxy, lower alkyl amino lower alkoxy, dilower alkylamino lower alkoxy, amino lower alkylene oxycarbonyl, lower alkylamino loweralkyleneoxy carbonyl, dilower alkylamino lower alkylene oxy carbonyl,  $OSi(R_{10}R_{11}R_{12})$  or
- 7        15  $Si(R_{17})(R_{18})(R_{19})$  and at least two of  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$  and  $R_8$  is loweralkoxy;
- 8            $R_9$  is hydrogen or lower alkyl; and
- 9            $R_{10}$ ,  $R_{11}$ ,  $R_{12}$ ,  $R_{17}$ ,  $R_{18}$  and  $R_{19}$  are
- 10          independently lower alkyl.
- 11        20 32. The compound according to Claim 31 wherein at least one of Y and Z is hydrogen.
- 12        33. The compound according to Claim 31 or 32, wherein Y is COOH, COOMe, CONHMe, COONHET,  $COO(CH_2)NET_2$ ,  $COO(CH_2)_2NMe_2$  or hydrogen and Z is hydrogen or COOH.
- 13        25 34. The compound according to any of Claims 31-33 wherein X is cis -HC=CH-;
- 14            $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$  and  $R_8$  are
- 15          independently hydrogen, lower alkyl, halo, amino, lower alkylamino, diloweralkylamino, lower alkoxy, lower arylalkoxy, cyano, aryloxy, mercapto, lower alkyl thio, amino lower alkyl, carboxy, carbolower alkoxy,  $CONHR_9$ ,  $NHCO(R_9)$ , lower alkanoyl, nitro,  $CF_3$ , lower alkyl

1 carbonyloxy, amino lower alkoxy, lower alkyl amino lower alkoxy, dilower alkylamino lower alkoxy, amino lower alkylene oxycarbonyl, lower alkylamino loweralkyleneoxy carbonyl, dilower alkylamino lower  
5 alkylene oxy carbonyl,  $OSi(R_{10}R_{11}R_{12})$  or  $Si(R_{17})(R_{18})(R_{19})$  and at least two of  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$  and  $R_8$  is loweralkoxy;  
 $R_9$  is hydrogen or lower alkyl; and  
 $R_{10}$ ,  $R_{11}$ ,  $R_{12}$ ,  $R_{17}$ ,  $R_{18}$  and  $R_{19}$  are  
10 independently lower alkyl.

35. The compound according to any of Claims 31-34 wherein at least three and at most six of  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$  or  $R_8$  is lower alkoxy.

36. The compound according to any of Claims 31-15 35 wherein three of  $R_1$ ,  $R_2$ ,  $R_3$  or  $R_4$  are lower alkoxy.

37. The compound according to any of Claims 31-36 wherein  $R_1$ ,  $R_2$  and  $R_4$  are independently hydrogen or lower alkoxy;

$R_3$  is hydrogen, lower alkoxy, arylalkoxy,  
20 loweralkyl carbonyloxy or  $OSi(R_{10}R_{11}R_{12})$ ;  
 $R_5$  is hydrogen, halo or lower alkoxy;  
 $R_6$  and  $R_8$  are independently hydrogen or lower alkoxy;

$R_7$  is hydrogen, lower alkoxy, lower alkyl,  
25 halo, lower alkyl carbonyloxy,  $OSi(R_{10}R_{11}R_{12})$ ,  $Si(R_{17})(R_{18})(R_{19})$ , amino,

$\begin{array}{c} O \\ || \\ \text{lower alkylamino, dilower alkylamino, } NHC-R_9, \\ \text{diloweralkyl-amino lower alkoxy, lower alkylthio,} \\ 30 \text{ mercapto or nitro;} \\ \text{ } \\ R_{10}, R_{11}, R_{12}, R_{17}, R_{18} \text{ and } R_{19} \text{ are} \\ \text{independently lower alkyl; and} \end{array}$

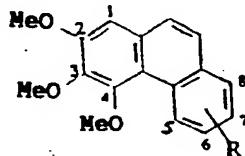
1           R<sub>9</sub> is lower alkyl or hydrogen.

38. The compound according to any of Claims  
31-37 wherein R<sub>1</sub> and R<sub>5</sub> are hydrogen.

39. The compound according to any of Claims  
5 31-38 wherein R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>, R<sub>6</sub>, R<sub>7</sub>, and R<sub>8</sub> are  
independently hydrogen or lower alkoxy.

40. The compound according to any of Claims  
31-39 wherein R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are lower alkoxy.

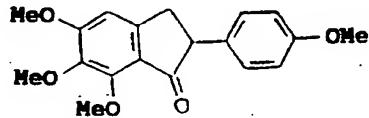
41. The compound selected from the group  
10 consisting of:



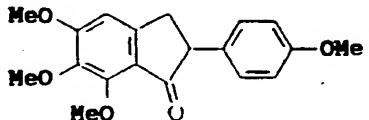
15

wherein R is C<sub>1-4</sub> lower alkoxy;

20



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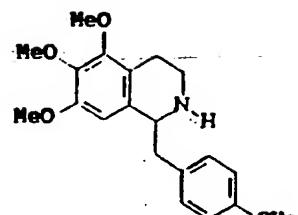
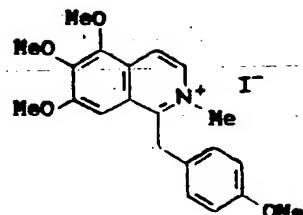


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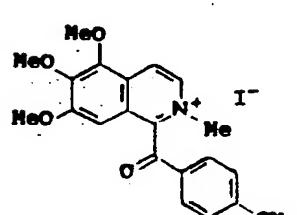
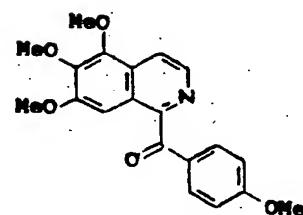
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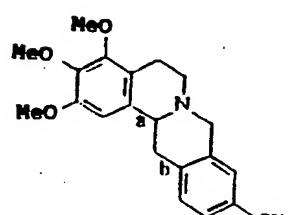
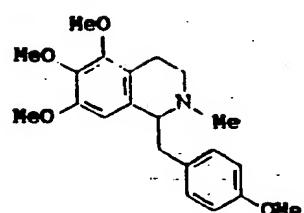


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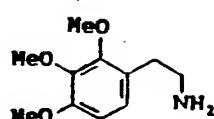
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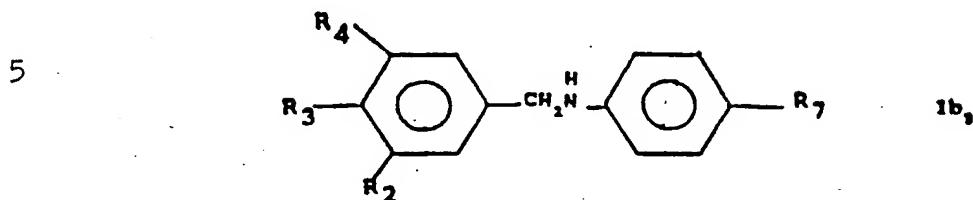
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1           42. The compound according to Claim 37 wherein  
the compound has the formula:



10         wherein R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are lower alkoxy and R<sub>7</sub> is hydrogen, lower alkyl, halo, thioloweralkyl, lower alkoxy, CF<sub>3</sub>, lower alkanoyl, formyl, carboxy, carboloweralkoxy, nitro, SO<sub>3</sub>H or cyano.

15         43. The compound of Claim 42 wherein R<sub>7</sub> is hydrogen, trifluoro-methyl, lower alkyl, halo, thioloweralkyl or lower alkoxy.

20         44. The compound according to any of Claims 42-43 which is 4-methyl-N-(3,4,5-trimethoxybenzyl)aniline, 4-ethyl-N-(3,4,5-trimethoxybenzyl)aniline, or 4-methoxy-N-(3,4,5-trimethoxybenzyl)aniline or pharmaceutically acceptable salts thereof.

25         45. A method for treating cancer in an animal which comprises administering to said animal in need of such treatment an anti-cancer effective amount of a compound according to any of Claims 31-44.

30         46. A pharmaceutical composition comprising a pharmaceutically effective amount of a compound according to any of Claims 31-44 and a pharmaceutical carrier therefor.

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